DOCUMENT RESUME

ED 162 761 PS 010 283

AUTHOR Vandenberg, Brian
TITLE The Role of Play in the Development of Insightful Tool-Using Strategies.
PUB DATE Aug 78
NOTE 24p.; Filmed from best available copy; Paper presented at the Annual Meeting of the American Psychological Association (86th, Toronto, Canada, August 28 - September 1, 1978)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Age Differences; Behavior Development; *Elementary School Students; *Object Manipulation; *Play; *Preschool Children; *Problem Solving; Research

ABSTRACT

This experiment investigates the relation of a free play experience to subsequent performance on problem solving tasks among children aged 4 to 10. Ninety children were divided into 3 age groups and were assigned in pairs of free play and non-play treatment conditions. Children were paired by block design test scores to control for perceptual motor differences. In the free play condition children were placed in the task setting and allowed to manipulate the experimental materials. Free play behavior was quantified by checklist guided observation. Children in the non-play condition were asked a series of questions about the materials. After treatments were individually administered, the child was given 2 tasks to perform. The most difficult task required the child to join sticks to get a colored block located behind a transparent barrier. The less difficult task required that the child remove a sponge from a transparent pipe. Increasingly informative hints were provided as required. Among the results it was found that the combined play group performed significantly better on the more difficult task. The 6- and 7-year-old children appeared to benefit most from the free play treatment. No relation was found between the number of acts performed in the free play condition and subsequent task performance. (RH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED162761

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

The Role of Play in the Development of Insightful Tool-Using Strategies

Brian Vandenberg

UCLA Neuropsychritric Institute

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Brian Vandenberg

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

PS 010283

Presented at the American Psychological Association meeting. August, 1978.

"The Role of Play in the Development
of Tool-Using Strategies"

Although play has long been considered an educationally and cognitively important activity for young children, empirical substantiation of these beliefs is sparse (Sutton-Smith, 1971). Research with primates has suggested that play is an important activity in the development of insightful, tool-using abilities (Bruner, 1972). Birch (1945) and Jackson (1942) each found that chimps who were given a play experience with a stick were later able to use the stick in a skilled way to solve a task requiring the acquisition of a distant lure. Schiller (1957), in a similar experiment, also found that play with several interlocking sticks had a significant impact on chimpanzees' later use of the sticks to acquire a lure.

Schiller's results diverge from Birch's on how the play experience aids later tool use. Birch's results suggest that play develops a generalized schema of action which is mobilized in the specific way required in the task, while Schiller's results indicate that play provides specific behavioral subassemblies which are later connected in the task solution. Since the task Schiller used was more difficult than the one used by Birch, it may be that performing task specifics in play is helpful for solving more difficult problems, and for easier tasks, only a generalized play experience is necessary.

More recently, Sylva, Bruner and Genova (1976) used a similar task to extend Birch and Schiller's findings to children three to five years of age. In the first of two experiments, Sylva et al. compared play to a demonstration condition and a control exposure to materials which then had to be used insightfully to solve a problem. Hints were given if the children had difficulty. The results indicated that the children in the play and demonstration conditions required fewer hints than the children in the control condition, while there was no difference between the play and demonstration groups.

In their second experiment, Sylva et al. yoked the children in the play condition of the first experiment to two new groups; a demonstration and training group. By yoking in this way, three children all were exposed to the same manipulation of the materials, but the nature of their exposure varied. The children in this second experiment were then given the same task that was given in the first experiment. Comparison of the performances on this task indicated that the play group required fewer hints than the other two groups, suggesting that the play experience was superior to the observe and training experiences as a means of interaction with the materials. In addition, Sylva et al. attempted to discover the importance of the richness of play in task performance, and they concluded that "the richness of the configuration to which the child is exposed affects his subsequent performance in problem solving" (p. 254).

These experiments raise several important questions. First, Sylva et al. found no age difference in the effect of play on problem solving. Thus; it is unclear if the impact of play change with age and task demands.

A second issue raised by Sylva et al. is the relation between play richness and task performance. Sylva et al. demonstrated that play

richness affects task performance, but what remains to be shown is that play richness aids task performance. In addition, there was no quantative assessment of what constitutes rich play.

Methodologically, in both experiments, Sylva et al.'s results are based on task scores which were assessed according to the number of hints given, with no adjustment for the level of the hint. Since the hints were scaled to reveal increasing amounts of information, two hints at the lowest level is not equivalent to a task performance which required two hints at the highest level.

The present study had three major aims. The first aim was to test the robustness of Sylva et al.'s findings across a larger age range using tasks of differing difficulty. The children were equally divided into three age groups so that an assessment could be made of the developmental impact of play in the use of insightful tool-using strategies. It was expected that the age of the children would influence the relative impact of the play experience. Because the younger children possess more rudimentary schemas for utilizing the materials, it was expected that they would benefit more from the play experience than the older children. Thus, it was hypothesized that overall, the play group would perform better on the tasks than the non-play group and that the impact of the play experience would be greater for the younger children.

A second aim was to assess the relationship between play richness and task performance. It was hypothesized that the play richness would be positively related to task performance, particularly for the younger children.

The third aim of this study was to address the Birch-Schiller controversy by examining the relative contribution of play richness and task specific play to subsequent performance on task of differening difficulty. It was predicted that play richness would aid task performance, regardless of task difficulty, while task specific play would improve performance on the more difficult task. Again, these relations were expected to hold for the younger but not necessarily the older children.

METHOD

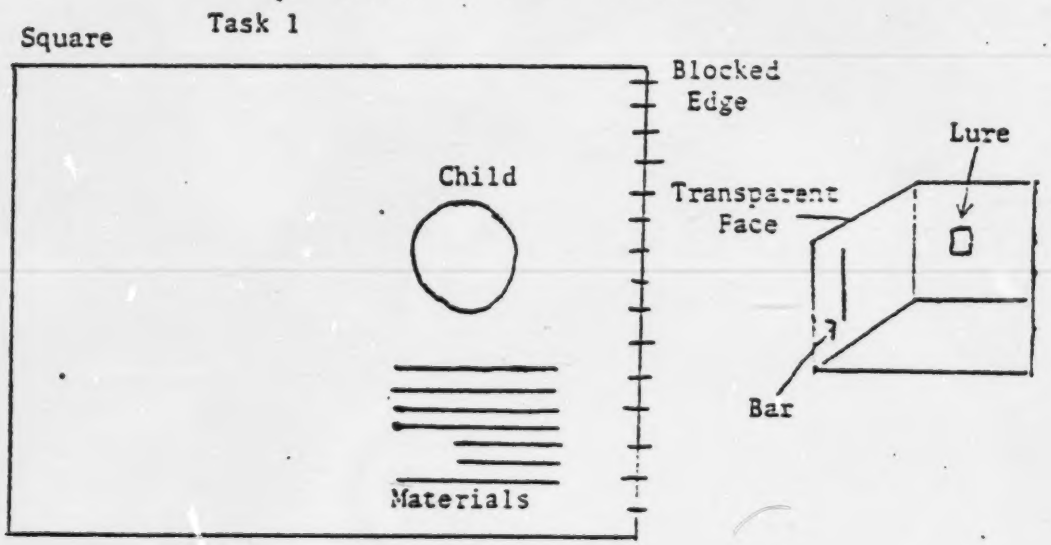
Subjects

Subjects were ninety children of both sexes between the ages of four and ten years. The groups were balanced by age so that there were thirty children in three age brackets; four to five, six to seven, and eight to ten years of age. Fifteen children in each group were in the play condition, while fifteen were assigned to a non-play condition. All of the subjects were white, middle class children who were drawn from two private schools. There were 19 females and 11 males in the youngest age group, 12 females and 18 males in the intermediary age group, and 16 females and 14 males in the oldest age group.

Tasks

Two tasks of varying difficulty were given to the children. In the more difficult task, the children were asked to stand in a square which had blocks along one edge. They were asked to retrieve a lure (colored block) in a box which was placed about three feet outside of the blocked edge of the square. The box had a transparent face which could be raised by a bar along its face. Play materials were placed in the square and the children were instructed that they could use anything in the square that they thought might be of help. To solve the task, the children had to tie two long notched sticks together with a pipe cleaner and use the joined stick to retrieve the object (see Figure 1).

Figure 1. The Task Setting



On the second task, the children were placed in the square with the play material and given a transparent pipe which had a piece of sponge lodged in it. The children were then instructed to get the object out of the pipe, and that they could use anything in the square that they thought might be of help. To solve this task, the children had to tie several pipe cleaners together to dislodge the object in the hole.

The number of goal directed acts performed by the children in Task 1 and Task 2 were counted. This measure was restricted to assessing the manual activity of the child, and included any constructive act aimed at solving the task. The reliability was assessed using the ratio: $\frac{\text{number of acts agree}}{\text{number of acts agree + number of acts disagree}}$; the reliabilities averaged .84.

Hints

A series of hints arranged so that each succeeding hint revealed more information about how to solve the task was developed for each task. The hints were similar to those used by Sylva et al., and were given during the tasks to the children if they were inactive for more than 20 seconds or indicated that they needed help. The particular hint that was given was depended upon the children's performance in the task. The children were given a hint which was one level above the strategies they had already attempted. For example, if the children attempted to reach the object with a stick, and then gave up, the children were then given the hint which suggested that they consider using both the sticks and the pipe cleaners. The level of the first hint, then, takes into consideration the previous strategies attempted by the children. If needed, additional hints were given in a similar manner.

On Task 1, there were six hints which revealed increasing amounts of information about the correct task solution. If a child were given only the second level hint, the child would receive more information than a child who received only the first level hint, but less information than someone given only the third level hint. Consequently, the task scores should indicate that successful solution of the task requiring only the second level hint was better than if only the third level hint was required, but not as good as if only the first level hint was needed.

On Task 1, the children were given one to five points respectively for each of the first five hints which were not needed. It was assumed that for the first five hints, the successive increments of information revealed was equal. The last hint, however, revealed the entire solution and a weighting of nine was given if it was not needed. A weighting of nine was used so that solving the task without the last hint was equivalent to solving the task without requiring the fourth and fifth hint (see Table 1). Similarly, for Task 2, the children were given one to three points respectively for not requiring each of the first three hints, and were given five additional points if the last hint was not needed (see Table 1).

Table 1. Scoring for Task 1 and Task 2

Points Given For Not Needing Hint

Level of Hint	Task 1	Task 2
Hint 1	1	1
Hint 2	2	2
Hint 3	3	3
Hint 4	4	5
Hint 5	5	
Hint 6	9	
TOTAL	24	11

Stimuli

The play materials consisted of eight notched sticks and six pipe cleaners. The eight sticks included: 4 sticks 5" x 1 1/4" x 1/8" with holes in the face, and a hole endwise; 2 sticks 13" x 1 1/4" x 1/8" with holes in the face of the stick; 2 sticks 15" x 1 1/4" x 1/8" with no holes. The notches in the sticks were big enough to allow the children to interlock the large and small sticks. The holes in the sticks were large enough to put the pipe cleaners through, and there were no holes in the 15" stick, to prevent alternative task solutions.

The six pipe cleaners were of various colors, and two sizes. Three pipe cleaners were 12" in length, while the other three were 6" long. The lure for the task condition was a colored block.

For the second task, a transparent plastic pipe 1/4" in diameter x 26" in length was used. A piece of sponge was the object lodged in the middle of the pipe.

The notched sticks and pipe cleaners are unique in several respects. Both the sticks and the pipe cleaners are open-ended materials which can be used in a number of different ways, and they are two distinctly different types of materials from which independent constructions can be made which do not require the use of the other type of play material.

Play Measures

The activity of the children in the play condition was scored as to: 1) the number of purposeful acts with the material; 2) the number of constructions made; 3) the number and type of materials used; 4) the duration of the children's play; 5) the performance of Task 1 and Task 2 specifics.

A purposeful act was defined as a manual act which altered the configuration of a play construction by adding, subtracting or changing the position of a stick or pipe cleaners. A new construction was defined as a configuration which was given a new or separate spatial location from existing constructions. The task specifics which were counted for Task 1 included tying a wire around a stick or sticks, and twisting pipe cleaners together. For Task 2, the specifics that were noted included twisting pipe cleaners together and putting a pipe cleaner in or through a hole.

It was assumed that children who performed more acts in their play had a richer ludic experience than those who utilized fewer acts. The contextual richness within which a play act was performed was also considered to be another important component of play richness. Thus, an act aimed at changing a construction containing a large number of materials was considered to be richer than an act involved in altering a smaller construction. A play richness score was developed to tap these two aspects of play richness and was equal to: $\sum_{j}^{N} \sum_{i}^{M}$ (number of materials in the construction for act $(i)\,j$; where m = number of acts per construction and n = number of constructions.

To establish the reliability of these play measures, the play of six children not used in the study was scored. There were three sessions in which two children were rated in each session. Each child was allowed to play with the materials for ten minutes while raters scored the play of each child from behind a one-way mirror. The reliability of the play score, the play score per act and the play score per construction was calculated using the analysis of variance to estimate reliability of measures (Winer, 1971, p. 283). The reliability of all three measures averaged in the .90's. The reliability of the number of acts and the

number of constructions was calculated using the ratio:

$$\frac{\text{number of acts agree}}{\text{number of acts agree + number of acts disagree}}$$

The reliability of the number of acts averaged .82, while the reliability of the number of constructions was .87.

Procedure

To control for possible differences in perceptual-motor abilities, the children between four and five years of age were given the block design subtest of the WPPSI, and the older children were given the WISC block design subtest. The children in each age group were ranked on their standardized score on the block design and then, using the randomized block design procedure, assigned to the experimental or control group. No attempt was made to control for sex. Each experimental child was yoked with a control child of similar ability on the block designs, and both received an equal amount of exposure time to the materials. The children were given the treatment condition first, and then the tasks. Each child was run individually.

In the experimental group, the children were given the task materials in a room with only the experimenter present. The children were seated on the floor and allowed to play with the materials. No attempt was made by the experimenter to interact with the children during this free play time, and the experimenter sat behind the children so as not to distract them. The children's use of the material during this period was scored by the experimenter. If the children ignored the material for more than one-half minute, the experimenter asked if they were finished. The play session was terminated if the children responded positively to this question, or if the children directly asserted, without the one-half minute's interlude, that they were finished.

In the control group, the children were not given a play experience, but instead were asked a series of questions about the materials. The questions included: "Which stick has the most holes in it? How many holes are there in all the sticks? How many pipe cleaners are there?", etc. The children were asked questions for the same length of time that their experimental yoke-mates played with the materials, insuring that the amount of time they were exposed to the materials was equal to their yoke-mates.

Next, a second rater joined the session, and the children were given the two tasks. The rater was not aware of which treatment the children received, and he scored their task performance. The experimenter administered the two tasks, and scored every fifth child as a reliability check. The tasks were administered in alternating order for each group to counterbalance possible order effects. The appropriate hints were given when necessary, the children's performances were recorded, and the task was terminated when the children had been given the last hint, failed to respond in a minute's time, or indicated that they were finished. At this time the children were shown how to do the task. During both the task and play conditions, the experimenter and rater made no attempt to interact with the children.

Results

Play vs. Non-Play

The hypothesis that play is a more potent experience for the development of insightful tool-using abilities was, in part, supported. Analysis of variance for Task 1 performance indicated that the play group performed better on the task than the non-play group ($F(1,42) = 6.34$, $p < .02$; see Tables 2, 3). There was no age by play interaction for Task 1, since

the play group scored higher than the non-play group at every age level. The results for Task 2, although in the predicted direction, failed to reach significance (see Tables 2, 4). It was also hypothesized that the play experience would be most beneficial for the younger children. This hypothesis was not fully supported. Matched groups t-test analysis for the two youngest age groups indicates that only the middle aged children's Task 1 performance was significantly enhanced by the play experience ($t(14) = 3.91$, $p < .001$). Similar analysis for Task 2 yielded a relationship which approached significance for the middle aged children ($t(14) = 1.61$, $p < .10$).

Analysis of variance of the number of goal directed acts for Task 1 indicates that there was a significant age effect ($F(2,42) = 5.49$, $p < .01$) and a significant age by play interaction ($F(2,42) = 3.78$, $p < .05$; see Table 5). For Task 2, there also was a significant age effect ($F(2,42) = 5.16$, $p < .01$), and the age by play interaction approached significance ($F(2,42) = 2.85$, $p < .10$, see Table 6). Matched t-test analysis for Task 1 indicated that the middle aged children in the play group used significantly fewer acts than their yoke-mates ($t(14) = 2.26$, $p < .05$). Thus, the children in the age group that benefited most from the play experience were also more efficient in their task activity; they scored significantly higher than their yoke-mates and required fewer acts to do so.

Table 2

Task Score Means and Standard Deviations

Variable	Condition	Age: 4-5	6-7	8-10
Task 1 $\bar{X}$	Play	7.1	15.5	21.3
	Control	5.8	7.7	18.6
Standard error		3.4	2.0	2.5
Task 2 $\bar{X}$	Play	6.1	8.6	10.4
	Control	6.2	7.1	10.2
Standard error		1.3	.9	.5

Table 3

Analysis of Variance for Task 1 Scores

Source	SS	df	MS	F	Prob.
Age	2768	2	1393	307	.001
Error	1934	42	47.2		
Play	344	1	344	6.34	.02
Play x Age	177	2	88.7	1.63	.20
Error	2280	42	54.3		

Table 4

Analysis of Variance for Task 2 Scores

Source	SS	df	MS	F	Prob.
Age	259	2	129	11.77	.001
Error	462	42	11.0		
Play	5.37	1	5.37	.79	.38
Play x Age	11.02	2	5.51	.81	.451
Error	285	42	6.80		

Table 5

Analysis of Variance of Task 1 Goal Directed

Source	SS	df	MS	F	Prob.
Age	4456	2	2228	5.49	.008
Error	17042	42	405		
Play	405	1	405	1.11	.30
Play x Age	2753	2	1376	3.78	.03
Error	15288	42	364		

Table 6

Analysis of Variance of Task 2 Goal Directed

Source	SS	df	MS	F	Prob.
Age	3002	2	1501	5.16	.01
Error	12218	42	290		
Play	448	1	448	2.03	.16
Play x Age	1258	2	629	2.85	.07
Error	9260	42	220		

The results supported the expectation that Task 1 would be more difficult than Task 2. Analysis of the number of spontaneous solvers (those who required no hints) and the number of children who did not require the final hint for each task, using McNamar's test for correlated proportions (Hays, 1973), indicated that Task 1 was more difficult than Task 2 (χ^2 = 11.1, 1 df, $p < .001$, χ^2 = 19.2, 1 df, $p < .0001$, respectively).

Play Richness, Task Specifics, and Task Scores

It was hypothesized that those children who played in a richer manner would perform better on the tasks regardless of task difficulty, and that the younger children would most likely benefit from richer play. There was little support for these hypotheses. There was no relation between play richness and performance on either task (see Table 7).

Table 7

Correlation of Play Richness and Task Specifics to Task Scores

	4-5 years		6-7 years		8-10 years	
	Task 1	Task 2	Task 1	Task 2	Task 1	Task 2
Specifics Task 1	-.05		-.06		.20	
Specifics Task 2		.54**		.42*		-.05
Play-Score	.35*	-.21	.14	-.26	-.35	.01
Play/Act	-.23	-.30	-.04	.05	.24	.05
Play/Const.	.29	-.23	-.22	-.12	.09	-.05
# Acts	.43**	-.09	.16	-.31	-.41*	-.01
# Const.	-.14	-.02	-.28	-.08	-.20	.07

*$p < .10$

**$p < .05$

It was hypothesized that task specific play would improve performance on the more difficult task. The results indicated that those who performed Task 2 specifics in their play had higher task scores than those who did not ($t(43) = 3.17$, $p < .01$). There also was a significant correlation between Task 2 specifics and task performance for the youngest children ($r = .54$, $p < .05$) (see Table 7).. There were, however, no significant relations between performance on the more difficult task and task specific play.

Discussion

The results provide moderate support for the hypothesis that play is an important factor for the development of insightful tool-using strategies. When the results are examined independent of age, the play experience was found to have a significant impact in Task 1 performance only. This suggests that the impact of a ludic experience may be influenced by the particular features of the task. This explanation is given additional credence by the fact that play aided performance on the task (1) that was most similar to that used by Sylva et al.

On Task 1, the intermediary aged children significantly benefited from the play experience. Although the results of Task 2 failed to reach significance, the pattern of the results was similar to Task 1, in that the intermediary aged children benefited most from the ludic experience, and required fewer acts than their yoke-mates. This suggests that play may have had a similar effect on Task 2 performance, but that the robustness of the effect may have been influenced by the task characteristics.

It was hypothesized that the younger children were more likely to benefit from play because they have more rudimentary schemas which would be elaborated by play. A more likely explanation of the results is that the play benefited those children whose abilities were most commensurate with the task demands. The mean task scores for the youngest children were very low (Table 2), and very few solved either task without needing hints. Contrariwise, the oldest children's mean task score were quite high, and many were able to solve both tasks without assistance. Thus, the tasks were too difficult for the youngest children to solve without help, but were quite easy for the oldest children to solve. The intermediary aged children, however, found the tasks to be of moderate difficulty, and their performance was enhanced by the play experience.

Although the tasks proved to be difficult for the youngest children, and easy for the oldest youngsters, the scoring system used was sensitive enough to make differenciations in the level of performance among the children in these age groups; the standard deviations of the children's task scores at the oldest and youngest ages are comparable to the intermediary aged children's, with the exception of the oldest children's Task 2 scores. Thus, the results are not a consequence of a "ceiling" and "floor" effect, but more likely reflect a lack of difference between the play and non-play groups at these ages.

One of Sylva et al.'s conclusions was the play richness affected task performance. The present study extended this conclusion by hypothesizing that play richness would positively influence task performance. The results, however, generally do not support this hypothesis. Overall, there was no significant relation between play richness and performance on either tasks, and there was only a modest positive relation for the youngest children on Task 1, and a modest negative correlation for the oldest children on the same task.

The lack of significant results may have been a consequence of the play richness measure used. Although an attempt was made to incorporate both the number of play acts and the contextual richness into the play measure, the high correlation between the number of acts and the play richness score ($r = .87$) indicates that the play richness score was heavily dominated by this factor. Perhaps a more differentiated analysis of the children's play which included qualitative aspects of the play activity would have shed more light on the relationship between play richness and task performance. Consequently, the lack of significant results may be due to the fact that the contextual richness of the play activity was not fully assessed.

Another related difficulty is the lack of conceptual clarity concerning what constitutes rich play. Play richness was first raised as an issue by Sylva et al., who used the term without attempting to define what is entailed in rich play. The present study hypothesized that the number of acts and contextual complexity are two factors of rich play, but there may be other aspects of play richness which have not yet been considered. For example, using the materials in a symbolic way may be richer than sensori-motor play with the materials. It is not clear, however, what criteria should be used to help define play richness. It is inviting to equate richer play with developmentally more mature play, but there are potential problems with this approach. It may be that the most developmentally mature way of playing with particular materials is to not play with the materials at all; not many adults would play for too long or in a very elaborate way with sticks and pipe cleaners. Thus, the inability to find significant relationships between play richness and task performance may be a consequence of the limitations of the play richness measure used, and the current lack of conceptual clarity about what is entailed in rich play.

The second issue addressed by the present study was the Birch-Schiller controversy. This disagreement focused on the way in which play aided subsequent problem solving using tools. Schiller's results indicated that play developed specific behavioral sub-assemblies which were later used in solving the task, while Birch's results indicated that such actions were not necessary. The results do not support Schiller's position that task specific play is necessary for later task solution. The intermediary aged children were able to solve the tasks without the aid of the task specifics, and overall, play aided the solution of Task 1, while task specific play assisted Task 2 performance. These results are more supportive of Birch's findings which indicated that play assisted in developing generalized schemas of action which were used in a specific way in the task.

It was hypothesized that since Schiller's task was more difficult than the one used by Birch, task specific play may be more helpful for solving the more difficult task. Contrary to prediction, task specific play aided performance on the easier task. Perhaps task difficulty is not the key to understanding this relationship. Rather, task specific play may be most helpful when the inferential distance between the task specific and task solution is small. The more insight into the task solution a particular task specific provides, the more helpful it is to perform the task specific in play.

There is some evidence which lends weight to this interpretation. The task specifics counted for Task 1 were tying a pipe cleaner around one or more sticks, and twisting pipe cleaners together. For Task 2, putting a pipe cleaner in or through a hole, and twisting pipe cleaners together were the task specifics noted. The second last hints on both

tasks verbalized a task specific. For Task 1, the hint was "you could tie the two long sticks together to make a longer stick," and for Task 2, the hint was "can you think of a way to tie two pipe cleaners together to help you." If both hints (and hence the task specifics) are of equal potency, then the same ratio in each task should proceed from the hint to task solution without requiring the final hint. The ratio of those requiring only the one hint to those requiring the last two hints was 12/42 for Task 1 and 26/18 for Task 2. McNamar's test for correlated proportions indicates that the Task 1 hint was significantly less helpful than its Task 2 counterpart (χ^2 (1) = 4.01, $p < .05$), which lends strength to the argument that the task specifics were not of equal potency.

The other specific for Task 1 was twisting two pipe cleaners together, and the second Task 2 specific was poking a pipe cleaner in or through a hole. This Task 1 specific is only an ancillary aspect of the task solution, while the Task 2 specific essentially entails the rest of the task solution which was not covered by the first Task 2 specific. Consequently, both the Task 2 specifics appear to be more potent components of the task solution than their Task 1 counterparts, and performing them in play is likely to aid subsequent task performance.

In sum, the results suggest that task specific play is not a component of play which is required for improved task performance. However, the performance of a particularly potent task specific of play is likely to aid later task performance.

References

Birch, H. G. The relation of previous experience to insightful problem solving. Journal of Comparative Psychology, 1945, 38, 267-283.

Bruner, J. The nature and uses of immaturity. American Psychologist, 1972, 27, 687-708.

Hays, W. L. Statistics for the Social Sciences. New York: Holt Rinehart & Winston, 1973.

Jackson, T. A. Use of the stick as a tool by young chimpanzees. Journal of Comparative Psychology, 1942, 34, 225-235.

Schiller, P. H. Innate motor action as a basis of learning. In C. H. Schiller (Ed.), Instinctive Behavior. New York: International Universities Press, 1957.

Sutton-Smith, B. The role of play in cognitive development. In R. E. Herron and B. Sutton-Smith (Eds.), Child's Play. New York: Wiley, 1971.

Sylva, L., Bruner, J. & Genova, P. The role of play in the problem solving of children 3-5 years of age. In J. Bruner, A. Jolly and K. Sylva (Eds.), Play: Its Role in Development and Evolution. New York: Basic Books, 1976.

Winer, B. J. Statistical Principles in Experimental Design. New York: McGraw-Hill, 1971.